

**Exhibit 1: EPA Tools for Schools Action Kit.****IAQ Backgrounder**

**T**he goal of the Checklist is to provide clear and easily applied activities that you can use to help prevent indoor air quality problems and resolve any problems promptly if they do arise. Once you understand the basic principles and factors that influence indoor air quality in your school, you will note that the specific activities involve two major actions - the management of pollutant sources, and the use of ventilation for pollutant control. This guidance is based on the following principles:

- Many IAQ problems can be prevented by school staff and students.
- When IAQ problems do arise, they can often be resolved using the skills of school staff.
- The expense and effort required to prevent most IAQ problems is much less than the expense and effort required to resolve problems after they develop.

**Why IAQ is Important to Your School**

Most people are aware that outdoor air pollution can damage their health, but many do not know that indoor air pollution can also have significant harmful effects. U.S. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels. These levels of indoor air pollutants may be of particular concern because it is estimated that most people spend about 90% of their time indoors. Comparative risk studies performed by EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top five environmental health risks to the public.

Failure to prevent indoor air problems, or failure to respond promptly, can have consequences such as:

- increasing the potential for long term and short term health problems for students and staff
- impacting the student learning environment, comfort, and attendance
- reducing performance of teachers and staff due to discomfort, sickness, or absenteeism
- accelerating deterioration and reducing efficiency of the school physical plant and equipment
- increasing the potential that schools will have to be closed, or occupants temporarily relocated
- straining relationships among school administration and parents and staff
- creating negative publicity that could damage a school's or administration's image and effectiveness
- creating potential liability problems

Indoor air problems can be subtle and do not always produce easily recognized impacts on health, well-being, or the physical plant. Children may be especially susceptible to air pollution. For this and the reasons noted above, air quality in schools is of particular concern - proper maintenance of indoor air is more than a "quality" issue, it encompasses safety and stewardship of our investment in the students, staff, and facilities.

**Understanding IAQ Problems and Solutions**

Over the past several decades, exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed

**Indoor Air Quality****Tools for Schools**

**Good indoor air quality contributes to a favorable learning environment for students, performance of teachers and staff, and a sense of comfort, health and well-being for all school occupants. These combine to assist a school in its core mission - educating children.**

buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of chemically-formulated personal care products, pesticides, and housekeeping supplies. In addition, our activities and our decisions, such as deferring maintenance to "save" money, lead to problems from sources and ventilation.

Four basic factors affect IAQ: sources of indoor air pollutants, heating, ventilation, and air-conditioning (HVAC) system, pollutant pathways, and occupants.

numerous particulates, fibers, mists, bioaerosols, and gases. It may be helpful to think of air pollutant sources as fitting into one of the categories in the table shown below.

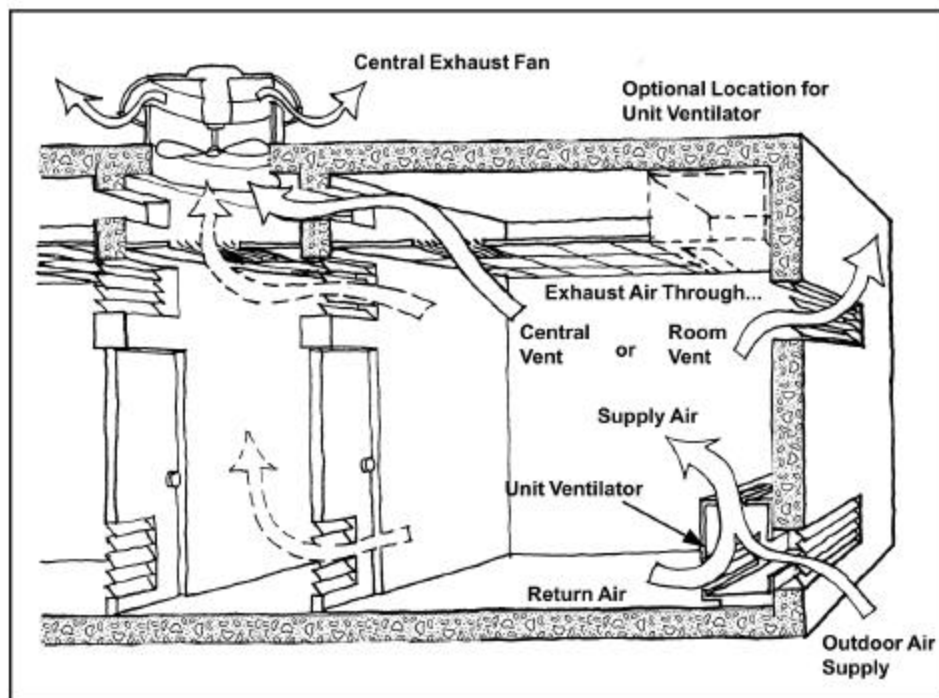
In addition to the number of potential pollutants, another complicating factor is that indoor air pollutant concentration levels can vary by time and location within the school building, or even a single classroom. Pollutants can be emitted from point sources, such as from science store rooms, or from area sources, such as newly painted surfaces, and pollutants can vary with time, such as only once each week when floor stripping is done, or continuously such as fungi growing in the HVAC system.

### Sources of Indoor Air Pollutants

Indoor air contaminants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, IAQ problems can arise, even if the HVAC system is properly operating. Air pollutants consist of

#### Typical Sources of Indoor Air Pollutants

Outside Sources Polluted Outdoor Air	Building Equipment HVAC Equipment	Components/Furnishings Components	Other Indoor Sources
<ul style="list-style-type: none"> <li>Pollen, dust, fungal spores</li> <li>Industrial emissions</li> <li>Vehicle emissions</li> </ul>	<ul style="list-style-type: none"> <li>Microbiological growth in drip pans, ductwork, coils, and humidifiers</li> <li>Improper venting of combustion products</li> <li>Dust or debris in ductwork</li> </ul>	<ul style="list-style-type: none"> <li>Microbiological growth on soiled or water-damaged materials</li> <li>Dry traps that allow the passage of sewer gas</li> <li>Materials containing volatile organic compounds, inorganic compounds, or damaged asbestos</li> <li>Materials that produce particles (dust)</li> </ul>	<ul style="list-style-type: none"> <li>Science laboratories</li> <li>Vocational arts areas</li> <li>Copy/print areas</li> <li>Food prep areas</li> <li>Smoking lounges</li> <li>Cleaning materials</li> <li>Emissions from trash</li> <li>Pesticides</li> <li>Odors and volatile organic compounds from paint, chalk, adhesives</li> <li>Occupants with communicable diseases</li> <li>Dry-erase markers and similar pens</li> <li>Insects and other pests</li> <li>Personal care products</li> </ul>
Nearby Sources	Non-HVAC Equipment	Furnishings	
<ul style="list-style-type: none"> <li>Loading docks</li> <li>Odors from dumpsters</li> <li>Unsanitary debris or building exhausts near outdoor air intakes</li> </ul>	<ul style="list-style-type: none"> <li>Emissions from office equipment (volatile organic compounds, ozone)</li> <li>Emissions from shops, labs, cleaning processes</li> </ul>	<ul style="list-style-type: none"> <li>Emissions from new furnishings and floorings</li> <li>Microbiological growth on or in soiled or water-damaged furnishings</li> </ul>	
Underground Sources			
<ul style="list-style-type: none"> <li>Radon</li> <li>Pesticides</li> <li>Leakage from underground storage tanks</li> </ul>			

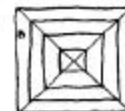


*How outdoor air is supplied through a unit ventilator.*

*Typical supply vents and return/exhaust grilles.*



Supply only \*



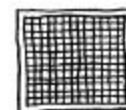
Supply only \*



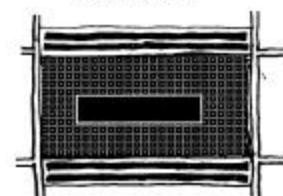
Could be either



Usually a return



Could be either



Usually a return if only one long slot on each side of light. \*

\*located only on ceilings, not walls

## HVAC System Design and Operation

The heating, ventilation, and air-conditioning (HVAC) system includes all heating, cooling, and ventilating equipment serving a school. A properly designed and functioning HVAC system:

- controls temperature and humidity to provide thermal comfort
- distributes adequate amounts of outdoor air to meet ventilation needs of school occupants
- isolates and removes odors and pollutants through pressure control, filtration, and exhaust fans

Not all HVAC systems are designed to accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control. The two most common HVAC designs used in schools are unit ventilators and central air handling systems. Both can perform the same HVAC functions, but the central air handling unit serves multiple rooms while the unit ventilator serves a single room.

The three building figures in this Backgrounder show typical methods for how outdoor air enters a room, and how exhaust air exits through a vent. If exhaust airflow through door or wall grilles into corridors is sealed due to fire codes, ensure that air has another path to reach the central exhaust.

## Pollutant Pathways and Driving Forces

Airflow patterns in buildings result from the combined forces of mechanical ventilation systems, human activity, and natural effects. Air pressure differences created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available openings in building walls, ceilings, floors, doors, windows, and HVAC system. An inflated balloon is an example of this driving force. As long as the opening to the balloon is kept shut, no air will flow, but when open, air will move from inside (area of higher pressure) to the outside (area of lower pressure).

Even if the opening is small, air will move until the pressures inside and outside are equal.

### Building Occupants

Building occupants in schools include the staff, students, and other people who spend extended periods of time in the school. The effects of IAQ problems on occupants are often non-specific symptoms rather than clearly defined illnesses. Symptoms commonly attributed to IAQ problems include:

- headache, fatigue, and shortness of breath
- sinus congestion, cough, and sneezing
- eye, nose, throat, and skin irritation
- dizziness and nausea

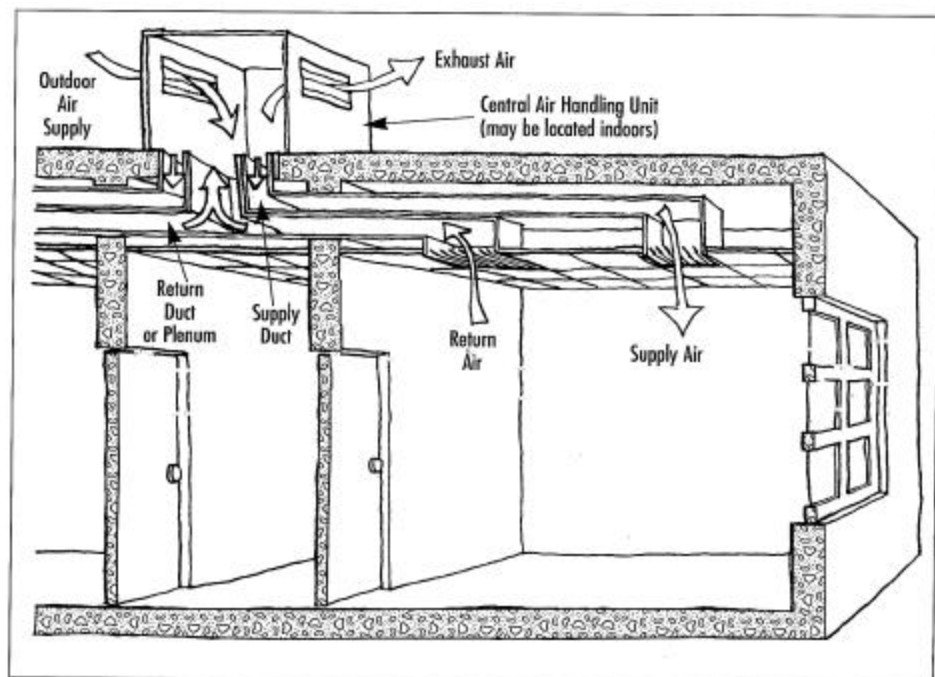
All of these symptoms, however, may also be caused by other factors, and are not necessarily due to air quality deficiencies. Environmental stressors such as improper lighting, noise, vibration, overcrowding, poor ergonomics, and psychosocial problems (such as job or home stress) can produce

symptoms that are similar to those associated with poor air quality, but require different solutions.

Because of varying sensitivity among people, one individual may react to a particular IAQ problem while surrounding occupants do not display ill effects. In other cases, complaints may be widespread. In addition to different degrees of reaction, an indoor air pollutant or problem can trigger different types of reactions in different people. Groups that may be particularly susceptible to effects of indoor air contaminants include, but are not limited to:

- allergic or asthmatic individuals, or people with sensitivity to chemicals
- people with respiratory disease
- people whose immune systems are suppressed due to radiation, chemotherapy, or disease
- contact lens wearers

*How outdoor air is supplied in a central air handling system.*



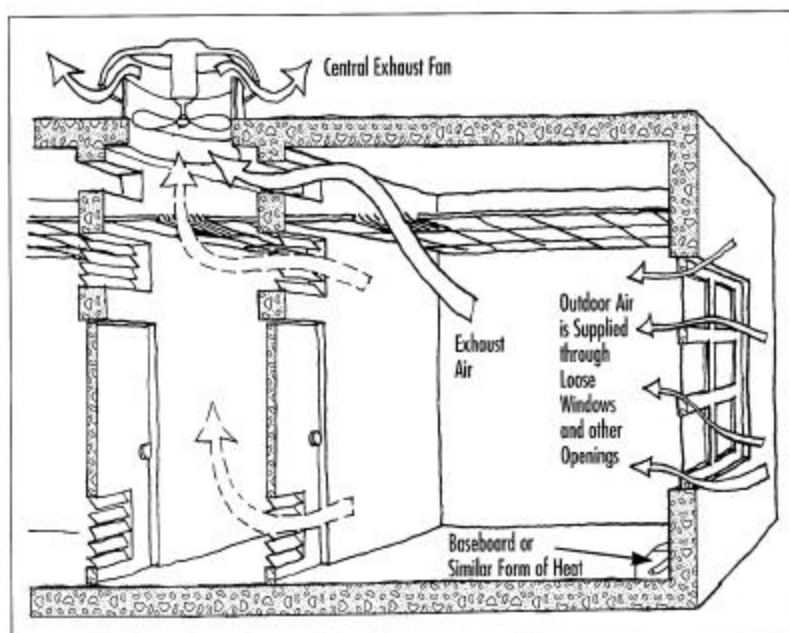
## Six Basic Control Strategies

There are six basic control methods for lowering concentrations of indoor air pollutants. Specific applications of these basic control strategies are noted in your Checklists.

**Source Management** includes source removal, source substitution, and source encapsulation. Source management is the most effective control method when it can be practically applied. Source removal is very effective. However, policies and actions that keep potential pollutants from entering the school are even better at preventing IAQ problems. Examples of source removal include not allowing buses to idle near outdoor air intakes, not placing garbage in rooms with HVAC equipment, and banning smoking within the school. Source substitution includes actions such as selecting a less toxic art material or interior paint than the products which are currently in use. Source encapsulation involves placing a barrier around the source so that it releases fewer pollutants into the indoor air (e.g., asbestos abatement, pressed wood cabinetry with sealed or laminated surfaces).

**Local Exhaust** is very effective in removing point sources of pollutants before they can disperse into the indoor air by exhausting the contaminated air outside. Well known examples include restrooms and kitchens where local exhaust is used. Other examples of pollutants that originate at specific points and that can be easily exhausted include science lab and housekeeping storage rooms, printing and duplicating rooms, and vocational/ industrial areas such as welding booths.

**Ventilation** through use of cleaner (outdoor) air to dilute the polluted (indoor) air that people are breathing. Generally, local building codes specify



the quantity (and sometimes quality) of outdoor air that must be continuously supplied to an occupied area. For situations such as painting, pesticide application, or chemical spills, temporarily increasing the ventilation can be useful in diluting the concentration of noxious fumes in the air.

**Exposure Control** includes adjusting the time of use and location of use. An example of time of use would be to strip and wax floors on Friday after school is dismissed, so that the floor products have a chance to off-gas over the weekend, reducing the level of odors or contaminants in the air when the school is occupied. Location of use deals with moving the contaminating source as far as possible from occupants, or relocating susceptible occupants.

**Air Cleaning** primarily involves the filtration of particles from the air as the air passes through the ventilation equipment. Gaseous contaminants can also be removed, but in most cases this type of system should be engineered on a case-by-case basis.

*How outdoor air is supplied in an exhaust-only system.*



## IAQ Checklists Available

- Teacher's
- Administrative Staff
- Health Officer's
- Ventilation
- Building Maintenance
- Food Service
- Waste Management
- Renovation and Repairs
- Walkthrough

**Education** of the school occupants regarding IAQ is critical. If people are provided information about the sources and effects of contaminants under their control, and about the proper operation of the ventilation system, they will better understand their indoor environment and can act to reduce their personal exposure.

## Your Role in the IAQ Team

As one of the people in your school, your activities and decisions have an impact on the quality of the indoor air in your school. You can participate by applying the activities noted in your Checklist, and by continuing to apply these principles on a daily basis. Someone from your school or district has taken the role of IAQ Coordinator, and serves as a focal point for collecting IAQ information and handling IAQ concerns.

## How Do You Know if You Have an IAQ Problem

Diagnosing symptoms that relate to IAQ can be tricky. Acute (short-term) symptoms of IAQ problems typically are similar to those from colds, allergies, fatigue, or the flu. There are clues that can serve as an indicator of a potential indoor air problem:

- the symptoms are widespread within a class or within the school
- the symptoms disappear when the students or staff leave the school building for a day
- the onset is sudden after some change at school, such as painting or pesticide application
- persons with allergies, asthma, or chemical sensitivities have reactions indoors but not outdoors

- a doctor has found that a student or staff member has an indoor air-related illness

However, a lack of symptoms does not ensure that IAQ is acceptable.

Symptoms from long-term health effects (such as lung cancer due to radon) often do not become evident for many years.

## What if You Think You Have an IAQ Problem

If you receive complaints that seem to indicate a potential IAQ problem and the problem is self-evident, then attempt to correct the problem. If the problem cannot be corrected, or if the complaint seems to indicate a potentially severe IAQ problem, contact the IAQ Coordinator immediately. The IAQ Coordinator may ask you questions to try to identify whether you have overlooked potential causes of the problem (such as, "Has anything changed since the last time you completed your Checklist?"), and then may call in other help from within or outside the school to investigate further.

## Communication

Because indoor air problems can jeopardize the health of students and staff, parents and the public may react strongly to reports of bad indoor air quality in your school. With this in mind, it is recommended that you follow the communications guidelines established by the IAQ Coordinator. Usually, this will involve referring questions from the public and media to one central source, the IAQ Coordinator for your school. In this way, students, parents, staff, and the public will not become alarmed by conflicting or wrong information, and will have a consistent and complete source of information regarding the quality of the indoor air in your school.